What is Claimed is:

1. A system for providing a flow of breathing gas to a patient comprising:

a gas flow generator adapted to provide a flow of breathing gas;

a gas flow controller associated with the gas flow generator and adapted to control the flow of breathing gas delivered to a patient responsive to a control signal;

a patient circuit coupled to the gas flow generator and adapted to communicate the flow of breathing with an airway of a patient;

a flow sensor adapted to measure the flow of breathing gas in the patient circuit and to output a first flow signal indicative thereof;

a pressure sensor adapted to measure a pressure of the flow of breathing gas in the patient circuit and to output a first pressure signal indicative thereof;

an exhaust assembly adapted to communicate gas from within the patient circuit to ambient atmosphere; and

a controller that receives the first flow signal and the first pressure signal and outputs the control signal that controls the flow of breathing gas delivered to the patient circuit by the pressure generating system and, hence, the flow of breathing gas at a patient's airway, wherein the controller detects onset of an inspiratory phase of a patient's breathing cycle for triggering the inspiratory flow of breathing gas based on such a patient's inspiratory effort, which is determined based on both the first flow signal and the first pressure signal.

2. The system according to claim 1, wherein the gas flow generating system includes:

a blower that receives a supply of breathing gas from a breathing gas source and provides the flow of breathing gas;

a flow controller associated with the blower to control a rate of the flow of breathing gas responsive to the flow control signal.

3. The system according to claim 2, wherein the flow controller is a flow restricting valve disposed in the patient circuit downstream of the blower that controls the rate of the flow of breathing gas by restricting a flow of gas in the patient circuit responsive to the flow control signal.

4. The system according to claim 1, wherein the flow sensor is disposed in the patient circuit at a location proximal to the gas flow generating system.

5. The system according to claim 1, wherein the patient circuit is a two-limb circuit with a first limb having a first end operatively connected to the gas flow generating system and a second end, and a second limb having a first end operatively connected to the exhaust assembly and a second end, wherein the second ends of the first and the second limbs are located proximal to an airway of a patient responsive to such a patient being ventilated by the ventilator.

6. The system according to claim 5, wherein the exhaust assembly includes an exhaust flow controller to control a rate of the exhaust flow of gas from the patient circuit responsive to an exhaust flow control signal provided by the controller.

7. The system according to claim 1, further comprising a secondary gas flow system that delivers a secondary flow of gas to the patient circuit, wherein the secondary gas flow system includes:

a conduit configured and arranged so as to communicate the secondary flow of gas from a source of the secondary flow of gas to the patient circuit; and

a second flow sensor adapted to measure the secondary flow of gas in the conduit and to output a second first signal indicative thereof.

8. The system according to claim 1, wherein the controller establishes a trigger lockout interval, which is a period of time during each expiratory phase of a breathing cycle in which triggering the inspiratory flow of breathing gas is prevented, based on at least one of the first flow signal and the first pressure signal.

9. The system according to claim 1, wherein the controller:

determines a patient flow difference ($Q_{patient}$- Q_{ref}), where $Q_{patient}$ is the current patient flow from the first flow signal and Q_{ref} is a reference patient flow determined from the first flow signal at a start of a trigger window;

determines a patient pressure difference(P_{ref} - $P_{patient}$), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at the start of a trigger window;

determines the patient's inspiratory effort as a product of the patient flow difference and the patient pressure difference; and

triggers the inspiratory flow responsive to the patient's inspiratory effort exceeding a threshold.

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10. The system according to claim 1, wherein the controller

determines a patient flow difference ($Q_{patient}$- Q_{ref}), where $Q_{patient}$ is the current patient flow from the first flow signal and Q_{ref} is a reference patient flow determined from the first flow signal at a start of a trigger window;

determines a patient pressure difference (P_{ref} - $P_{patient}$), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at the start of the trigger window;

determines the patient's inspiratory effort as a product of the patient flow difference and the patient pressure difference;

sums the patient's inspiratory efforts accumulated over a time interval; and

triggers the inspiratory flow responsive to the sum of the patient's inspiratory efforts over the time interval exceeding a threshold.

11. The system according to claim 10, wherein the time interval has fixed duration.

12. The system according to claim 1, wherein the controller:

determines a patient pressure difference (P_{ref} - $P_{patient}$), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at a start of a trigger window;

delays the patient pressure difference in time to determine a delayed patient pressure difference;

determines a product of a current patient flow from the first flow signal and the delayed patient pressure difference as the patient's inspiratory effort;

sums the patient's inspiratory efforts accumulated over a time interval; and

triggers the inspiratory flow responsive to the sum of the patient's inspiratory effort exceeding a threshold.

13. The system according to claim 1, wherein the controller detects onset of an expiratory phase of a patient's breathing cycle for cycling from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly based on such a patient's expiratory effort, which is determined based on both the first flow signal and the first pressure signal.

14. The system according to claim 13, wherein the controller:

determines a patient flow difference (Q_{ref} - $Q_{patient}$), where $Q_{patient}$ is the current patient flow from the first flow signal and Q_{ref} is a reference patient flow determined from the first flow signal at a start of a cycling window;

determines a patient pressure difference ($P_{patient}$ - P_{ref}), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at the start of the cycling window;

determines the patient's expiratory effort as a product of the patient flow difference and the patient pressure difference; and

cycles from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly responsive to the patient's expiratory effort exceeding a threshold.

15. The system according to claim 13, wherein the controller:

determines a patient pressure difference ($P_{patient}$ - $P_{ref,}$), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at a start of a cycling window;

delays a patient flow from the first flow signal to determine a delayed patient flow;

determines a product of the current patient pressure difference and the delayed patient flow as the patient's expiratory effort;

sums the patient's expiratory efforts accumulated over a time interval; and

cycles from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly responsive to the sum of the patient's expiratory effort exceeding a threshold.

16. The system according to claim 13, wherein the controller:

determines a patient flow difference (Q_{ref}- $Q_{patient}$), where $Q_{patient}$ is the current patient flow from the first flow signal and Q_{ref} is a reference patient flow determined from the first flow signal at a start of a cycling window;

determines a patient pressure difference ($P_{patient}$ - P_{ref}), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at the start of the cycling window;

determines the patient's expiratory effort as a product of the patient flow difference and the patient pressure difference;

sums the patient's expiratory efforts accumulated over a time interval; and

cycles from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly responsive to the sum of the patient's expiratory efforts over the time interval exceeding a threshold.

17. The system according to claim 16, wherein the time interval has fixed duration.

18. The system according to claim 1, wherein the controller cycles from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly by comparing patient flow determined from the first flow signal against a cycle threshold flow and cycles responsive to the patient flow falling below the cycle threshold flow.

19. The system according to claim 18, wherein the controller:

monitors patient pressure, via the first pressure signal, at an end portion of the inspiratory phase and monitors patient flow, via the first flow signal, at a beginning portion of the expiratory phase to determine whether the system cycled too early or too late; and

adjusts the cycle threshold flow for a next breathing cycle responsive to a determination that the system cycled too early or too late.

20. A system for providing a flow of breathing gas to a patient comprising:

a gas flow generator adapted to provide a flow of breathing gas;

a gas flow controller associated with the gas flow generator and adapted to control the flow of breathing gas delivered to a patient responsive to a control signal;

a patient circuit coupled to the gas flow generator and adapted to communicate the flow of breathing with an airway of a patient;

a flow sensor adapted to measure the flow of breathing gas in the patient circuit and to output a first flow signal indicative thereof;

a pressure sensor adapted to measure a pressure of the flow of breathing gas in the patient circuit and to output a first pressure signal indicative thereof;

an exhaust assembly adapted to communicate gas from within the patient circuit to ambient atmosphere; and

a controller that receives the first flow signal and the first pressure signal and outputs the control signal that controls the flow of breathing gas delivered to the patient circuit by the pressure generating system and, hence, the flow of breathing gas at a patient's airway, wherein the controller arms a plurality of triggering mechanisms over an expiratory phase of a breathing cycle to increase the ventilator system sensitivity to a patient initiated trigger as the expiratory phase of the breathing cycle progresses.

21. A method of providing a flow of breathing gas to a patient comprising:

generating a flow of breathing gas;

providing the flow of breathing gas to a patient via a patient circuit;

controlling the flow of breathing gas delivered to a patient responsive to a control signal;

measuring the flow of breathing in the patient circuit and outputting a first flow signal indicative thereof;

measuring a pressure of the flow of breathing gas in the patient circuit and outputting a first pressure signal indicative thereof;

communicating gas from within the patient circuit to ambient atmosphere; and

detecting onset of the inspiratory phase of a patient's breathing cycle for triggering an inspiratory flow of breathing gas based on such a patient's inspiratory effort, which is determined based on both the first flow signal and the first pressure signal.

22. The method according to claim 21, wherein detecting the onset of the inspiratory phase includes:

determining a patient flow difference ($Q_{patient}$- Q_{ref}), where $Q_{patient}$ is the current patient flow from the first flow signal and Q_{ref} is a reference patient flow determined from the first flow signal at a start of a trigger window;

determining a patient pressure difference (P_{ref} - $P_{patient}$), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at the start of the trigger window; and

determining the patient's inspiratory effort as a product of the patient flow difference and the pressure difference.

23. The method according to claim 22, further comprising triggering the inspiratory flow responsive to the patient's inspiratory effort exceeding a threshold.

24. The method according to claim 21, wherein detecting the onset of the inspiratory phase includes:

determining a patient flow difference ($Q_{patient}$- Q_{ref}), where $Q_{patient}$ is the current patient flow from the first flow signal and Q_{ref} is a reference patient flow determined from the first flow signal at a start of a trigger window;

determining a patient pressure difference (P_{ref} - $P_{patient}$), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at a start of a trigger window;

determining the patient's inspiratory effort as a product of a patient flow difference and the pressure difference;

summing the patient's inspiratory efforts accumulated over a time interval; and

triggering the inspiratory flow responsive to the sum of the patient's inspiratory efforts over the time interval exceeding a threshold.

25. The method according to claim 24, wherein the time interval has a fixed duration.

26. The method according to claim 21, wherein detecting the onset of the inspiratory phase includes:

determining a patient pressure difference (P_{ref} - $P_{patient}$), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at a start of a trigger window;

determining a delayed patient pressure difference, where the length of the delay is selected so as to account for an inherent physiological delay between the onset of a pressure drop and a rise in patient flow occurring at a beginning of inspiration;

determining a product of a current patient flow from the first flow signal and the delayed patient pressure difference as the patient's inspiratory effort;

summing the patient's inspiratory efforts accumulated over a time interval; and

triggering the inspiratory flow responsive to the sum of the patient's inspiratory effort exceeding a threshold.

27. The method according to claim 21, further comprising detecting onset of an expiratory phase of a patient's breathing cycle for cycling from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly based on such a patient's expiratory effort, wherein detecting the onset of the expiratory phase is determined based on both the first flow signal and the first pressure signal.

28. The method according to claim 27, wherein detecting the onset of the expiratory phase includes:

determining a patient flow difference (Q_{ref} - $Q_{patient}$), where $Q_{patient}$ is the current patient flow from the first flow signal and Q_{ref} is a reference patient flow determined from the first flow signal at a start of a cycling window;

determining a patient pressure difference ($P_{patient}$ - P_{ref}), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at the start of the cycling window;

determining the patient's expiratory effort as a product of the patient flow difference and the patient pressure difference; and

cycling from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly responsive to the patient's expiratory effort exceeding a threshold.

29. The method according to claim 27, wherein detecting the onset of the expiratory phase includes:

determining a patient pressure difference ($P_{patient}$ - $P_{ref,}$), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at a start of a cycling window;

delaying a patient flow from the first flow signal to determine a delayed patient flow;

determining a product of the current patient pressure difference and the delayed patient flow as the patient's expiratory effort;

summing the patient's expiratory efforts accumulated over a time interval; and

cycling from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly responsive to the sum of the patient's expiratory effort exceeding a threshold.

30. The method according to claim 27, wherein detecting the onset of the expiratory phase includes:

determining a patient flow difference (Q_{ref} - $Q_{patient}$), where $Q_{patient}$ is the current patient flow from the first flow signal and Q_{ref} is a reference patient flow determined from the first flow signal at a start of a cycling window;

determining a patient pressure difference ($P_{patient}$ - $P_{ref,}$), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at the start of the cycling window;

determining the patient's expiratory effort as a product of the patient flow difference and the patient pressure difference;

summing the patient's expiratory efforts accumulated over a time interval; and

cycling from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly responsive to the sum of the patient's expiratory efforts over the time interval exceeding a threshold.

31. The method according to claim 30, wherein the time interval has a fixed duration.

32. The method according to claim 21, wherein the controller cycles from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly by comparing patient flow determined from the first flow signal against a cycle threshold flow and cycles responsive to the patient flow falling below the cycle threshold flow.

33. The method according to claim 32, further comprising:

monitoring patient pressure, via the first pressure signal, at an end portion of the inspiratory phase;

monitoring patient flow, via the first flow signal, at a beginning portion of the expiratory phase;

determining whether the system cycled too late based on the monitored patient pressure at the end portion of the inspiratory phase

determining whether the system cycled too early based on the monitored patient flow at the beginning portion of the expiratory phase; and

adjusting the cycle threshold flow for a next breathing cycle responsive to a determination that the system cycled too early or too late.

34. A method of providing a flow of breathing gas to a patient comprising:

generating a flow of breathing gas;

providing the flow of breathing gas to a patient via a patient circuit;

controlling the flow of breathing gas delivered to a patient responsive to a control signal;

measuring the flow of breathing in the patient circuit and outputting a first flow signal indicative thereof;

measuring a pressure of the flow of breathing gas in the patient circuit and outputting a first pressure signal indicative thereof;

communicating gas from within the patient circuit to ambient atmosphere; and

activating a plurality of triggering mechanisms over an expiratory phase of a breathing cycle to increase a sensitivity to a patient initiated trigger as the expiratory phase of the breathing cycle progresses.

35. A system for providing a flow of breathing gas to a patient comprising:

a gas flow generator adapted to provide a flow of breathing gas;

a gas flow controller associated with the gas flow generator and adapted to control the flow of breathing gas delivered to a patient responsive to a control signal;

a patient circuit coupled to the gas flow generator and adapted to communicate the flow of breathing with an airway of a patient;

a flow sensor adapted to measure the flow of breathing gas in the patient circuit and to output a first flow signal indicative thereof;

a pressure sensor adapted to measure a pressure of the flow of breathing gas in the patient circuit and to output a first pressure signal indicative thereof;

an exhaust assembly adapted to communicate gas from within the patient circuit to ambient atmosphere; and

a controller that receives the first flow signal and the first pressure signal and outputs the control signal that controls the flow of breathing gas delivered to the patient circuit by the pressure generating system and, hence, the flow of breathing gas at a patient's airway, wherein the controller detects onset of the expiratory phase of a patient's breathing cycle for cycling the expiratory flow of breathing gas based on such a patient's expiratory effort, which is determined based on both the first flow signal and the first pressure signal.

36. The system according to claim 35, wherein the controller:

determines a patient flow difference (Q_{ref} - $Q_{patient}$), where $Q_{patient}$ is the current patient flow from the first flow signal and Q_{ref} is a reference patient flow determined from the first flow signal at a start of a cycling window;

determines a patient pressure difference ($P_{patient}$ - P_{ref}), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at the start of a cycling window;

determines the patient's expiratory effort as a product of the patient flow difference and the patient pressure difference; and

cycles from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly responsive to the patient's expiratory effort exceeding a threshold.

37. The system according to claim 35, wherein the controller:

determines a patient pressure difference ($P_{patient}$ - $P_{ref,}$), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at a start of a cycling window;

delays a patient flow from the first flow signal to determine a delayed patient flow;

determines a product of the current patient pressure difference and the delayed patient flow as the patient's inspiratory effort;

sums the patient's inspiratory efforts accumulated over a time interval; and

cycles from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly responsive to the sum of the patient's expiratory effort exceeding a threshold.

38. The system according to claim 35, wherein the controller:

determines a patient flow difference (Q_{ref}- $Q_{patient}$), where $Q_{patient}$ is the current patient flow from the first flow signal and Q_{ref} is a reference patient flow determined from the first flow signal at a start of a cycling window;

determines a patient pressure difference ($P_{patient}$ - P_{ref},), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at the start of the cycling window;

determines the patient's expiratory effort as a product of the patient flow difference and the patient pressure difference;

sums the patient's expiratory efforts accumulated over a time interval; and

cycles from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly responsive to the sum of the patient's expiratory efforts over the time interval exceeding a threshold.

39. The system according to claim 38, wherein the time interval is a fixed period of time.

40. A method of providing a flow of breathing gas to a patient comprising:

generating a flow of breathing gas;

providing the flow of breathing gas to a patient via a patient circuit;

controlling the flow of breathing gas delivered to a patient responsive to a control signal;

measuring the flow of breathing in the patient circuit and outputting a first flow signal indicative thereof;

measuring a pressure of the flow of breathing gas in the patient circuit and outputting a first pressure signal indicative thereof;

communicating gas from within the patient circuit to ambient atmosphere; and

detecting onset of the expiratory phase of a patient's breathing cycle for cycling an expiratory flow of breathing gas based on such a patient's expiratory effort, which is determined based on both the first flow signal and the first pressure signal.

41. The method according to claim 40, wherein detecting the onset of the expiratory phase includes:

determining a patient flow difference (Q_{ref}- Q_{ref}), where $Q_{patient}$ is the current patient flow from the first flow signal and Q_{ref} is a reference patient flow determined from the first flow signal at a start of a cycling window;

determining a patient pressure difference ($P_{patient}$ - P_{ref}), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at the start of a cycling window;

determining the patient's expiratory effort as a product of the patient flow difference and the patient pressure difference; and

cycling from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly responsive to the patient's expiratory effort exceeding a threshold.

42. The method according to claim 40, wherein detecting the onset of the expiratory phase includes:

determining a patient pressure difference ($P_{patient}$ - $P_{ref,}$), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at a start of a cycling window;

delaying a patient flow from the first flow signal to determine a delayed patient flow;

determining a product of the current patient pressure difference and the delayed patient flow as the patient's expiratory effort;

summing the patient's expiratory efforts accumulated over a time interval; and

cycling from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly responsive to the sum of the patient's expiratory effort exceeding a threshold.

43. The method according to claim 40, wherein detecting the onset of the expiratory phase includes:

determining a patient flow difference (Q_{ref}- $Q_{patient}$), where $Q_{patient}$ is the current patient flow from the first flow signal and Q_{ref} is a reference patient flow determined from the first flow signal at a start of a cycling window;

determining a patient pressure difference ($P_{patient}$ - P_{ref},), where $P_{patient}$ is the current patient pressure from the first pressure signal and P_{ref} is a reference patient pressure determined from the first pressure signal at the start of the cycling window;

determining the patient's expiratory effort as a product of the patient flow difference and the patient pressure difference;

summing the patient's expiratory efforts accumulated over a time interval; and

cycling from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly responsive to the sum of the patient's expiratory efforts over the time interval exceeding a threshold.

44. The method according to claim 44, wherein the time interval is a fixed duration.

45. A system for providing a flow of breathing gas to a patient comprising:

a gas flow generator adapted to provide a flow of breathing gas;

a gas flow controller associated with the gas flow generator and adapted to control the flow of breathing gas delivered to a patient responsive to a control signal;

a patient circuit coupled to the gas flow generator and adapted to communicate the flow of breathing with an airway of a patient;

a flow sensor adapted to measure the flow of breathing gas in the patient circuit and to output a first flow signal indicative thereof;

a pressure sensor adapted to measure a pressure of the flow of breathing gas in the patient circuit and to output a first pressure signal indicative thereof;

an exhaust assembly adapted to communicate gas from within the patient circuit to ambient atmosphere; and

a controller that receives the first flow signal and the first pressure signal, wherein the controller detects onset of the expiratory phase of a patient's breathing cycle, for cycling the system from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly, responsive to a patient flow determined from the first flow signal falling below the cycle threshold flow, wherein the controller monitors patient pressure, via the first pressure signal, at an end portion of the inspiratory phase to determine whether the system cycled too late and monitors patient flow, via the first flow signal, at a beginning portion of the expiratory phase to determine whether the system cycled too early, and wherein the controller adjusts the cycle threshold flow for a next breathing cycle responsive to a determination that the system cycled too early or too late.

46. A method of providing a flow of breathing gas to a patient comprising:

generating a flow of breathing gas;

providing the flow of breathing gas to a patient via a patient circuit;

controlling the flow of breathing gas delivered to a patient responsive to a control signal;

measuring the flow of breathing in the patient circuit and outputting a first flow signal indicative thereof;

measuring a pressure of the flow of breathing gas in the patient circuit and outputting a first pressure signal indicative thereof;

communicating gas from within the patient circuit to ambient atmosphere; and

detecting onset of the expiratory phase of a patient's breathing cycle for cycling the system from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly, by comparing a patient flow determined from the first flow signal with a cycle threshold flow;

cycling the system from providing the inspiratory flow to allowing an expiratory flow of breathing gas from the exhaust assembly responsive to the patient flow falling below the cycle threshold flow;

determining whether the system cycled too late based on the patient pressure at an end portion of the inspiratory phase;

determining whether the system cycled too early based on the patient flow at a beginning portion of the expiratory phase; and

adjusting the cycle threshold flow for a next breathing cycle responsive to a determination that the system cycled too early or too late.